

APPLICATION UNDER UNITED STATES PATENT LAWS

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Invention: OPTICAL PICKUP DEVICE AND OPTICAL DISK DEVICE

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This is a:

- ☐ Provisional Application
- ☒ Regular Utility Application
- ☐ Continuing Application
 - ☐ The contents of the parent are incorporated by reference
- ☐ PCT National Phase Application
- ☐ Design Application
- ☐ Reissue Application
- ☐ Plant Application
- ☐ Substitute Specification
 - Sub. Spec Filed _____
 - in App. No. _____ / _____
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SPECIFICATION

TITLE OF THE INVENTION

OPTICAL PICKUP DEVICE AND OPTICAL DISK DEVICE

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is based upon and claims the
5 benefit of priority from the prior Japanese Patent
Application No. 2002-191395, filed June 28, 2002, the
entire contents of which are incorporated herein by
reference.

BACKGROUND OF THE INVENTION

10 1. Field of the Invention

The present invention relates to an optical pickup
device which performs recording/reproducing processing
to an optical disk and an optical disk device using the
same, and particularly relates to an optical pickup
15 device which has a flexible substrate having a short-
circuit wiring portion and an optical disk device using
the same.

2. Description of the Related Art

In recent years, optical disks become widespread
20 and high performance is required for optical disk
devices for performing recording/reproducing
processing. In a conventional optical disk device, a
high-frequency wave of about 350 MHz is superimposed on
a semiconductor laser diode mounted on an integrated
25 optical unit IOU in the optical pickup device from a
driving circuit of the semiconductor laser diode formed
on a flexible substrate, in order to improve signal

characteristics during reproducing a DVD (Digital Versatile Disc).

However, in case of a long distance between the integrated optical unit on which the semiconductor laser diode is mounted and the driving circuit on the flexible substrate, because of superimposing the high-frequency, attenuation of a driving signal and generation of heat occur under the influence of line inductance in a wiring path detouring on the flexible substrate. This causes a serious problem in the case of writing processing, which requires laser driving current of about tenfold of energy compared with read of a ROM (Read Only Memory), and also a problem of degradation of writing characteristics.

That is, in the flexible substrate of the conventional optical pickup apparatus, when the high-frequency wave is superposed on the semiconductor laser diode in reproducing DVD and CD, in the case of the long wiring path between the semiconductor laser diode and the driving circuit on the flexible substrate, the attenuation of the driving signal and the generation of heat occur under the influence of line inductance. Also, an unnecessary electromagnetic wave is also generated, which results in the degradation of the writing characteristics into the optical disk.

BRIEF SUMMARY OF THE INVENTION

According to one aspect of the present invention,

there is an optical pickup device comprises a frame; an integrated optical unit incorporated in the frame and equipped with a first semiconductor laser diode; a flexible substrate having a first connector on one end thereof, a second connector on other end thereof, and a first short-circuit wiring pathway connected between the first connector and the second connector; and a driving circuit formed on the flexible substrate for driving the first semiconductor laser diode, wherein the flexible substrate is wound along the frame, so that the first connector of the short-circuit wiring pathway is connected to the optical unit and thereby connected to the semiconductor laser diode, and the second connector is connected to the driving circuit, which allows driving current to be supplied from the driving circuit to the semiconductor laser diode through the short-circuit wiring pathway.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWING

FIG. 1 is a view showing an example of a flexible substrate for use in an optical pickup device according to an embodiment of the invention;

FIG. 2 is a view showing an example of the optical pickup device equipped with the flexible substrate according to the embodiment of the invention;

FIG. 3 is an enlarged view showing an example of the optical pickup device equipped with the flexible substrate according to the embodiment of the invention;

FIG. 4 is a view showing a backside of an example of the flexible substrate and the optical pickup device according to the embodiment of the invention;

5 FIG. 5 is a view for comparison of a wiring path on the flexible substrate to a short-circuit wiring portion according to the embodiment of the invention; and

10 FIG. 6 is a view showing an example of an optical disk device in which the optical pickup device according to the embodiment of the invention is used.

DETAILED DESCRIPTION OF THE INVENTION

Referring to the accompanying drawings, an optical pickup device and an optical disk device of a preferred embodiment of the invention will be described in detail below. FIG. 1 is a view showing an example of a flexible substrate for use in the optical pickup device according to the embodiment of the invention, FIG. 2 is a view showing an example of the optical pickup device equipped with the flexible substrate according, FIG. 3 is an enlarged view showing an example of the optical pickup device equipped with the flexible substrate, FIG. 4 is a view showing a backside of an example of the flexible substrate and the optical pickup device, FIG. 5 is a view for comparison of a wiring path on the flexible substrate to a short-circuit wiring portion, and FIG. 6 is a view showing an example of an optical disk device in which the optical pickup

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device is used.

(Optical pickup apparatus and optical disk device)

In these figures, the optical pickup device includes an optical pickup unit (PU) shown in FIG. 2, which is equipped with a flexible substrate F shown in FIG. 1. The flexible substrate F includes an integrated circuit 15 having a driving circuit for driving a semiconductor laser diode emitting a laser beam, an integrated optical unit 21 for, e.g. DVD, on which the semiconductor laser diode is mounted, and an actuator 22 having a lens L mounted thereon and controlling an irradiating direction of the laser beam in a focusing direction and a tracking direction. As shown in FIG. 4, the flexible substrate F further includes an integrated optical unit 23 for, e.g. CD, and semiconductor laser diodes 11 and 11b, which are mounted on the integrated optical units 21 and 23, respectively, are driven with a driving circuit in the integrated circuit 15. In addition to the semiconductor laser diodes 11 and 11b emitting the laser beam, the integrated optical units 21 and 23 have electronic components such as a capacitor and a resistor and a function of hologram diffraction.

The laser beam emitted from each semiconductor laser diode in the integrated optical units 21 and 23 is condensed with the lens L provided on the actuator through an optical path, an optical disk (not shown) is

irradiated with the laser beam, and recording processing and the reproducing processing are performed.

FIG. 6 is a schematic view showing an example of an optical disk device B equipped with the optical pickup device. The optical disk device B includes a pickup unit PU formed in a chassis 32 provided on a drawer 31, and a spindle motor M rotating the optical disk at a predetermined rotational speed. The optical disk device B also includes a spindle driving circuit (not shown) for driving the spindle motor M, and a focusing control circuit and a tracking control circuit for performing focusing control and tracking control of an actuator 24 by receiving plural detected signals from plural photodetectors (not shown) in the integrated optical units 21 and 23 in the pickup unit PU to generate a focusing error signal and a tracking error signal, respectively. Further, the optical disk device B has a control circuit for controlling the whole operation and an interface portion for communicating with an external device by the detected signal or a recording/reproducing signal. (Short-circuit wiring between semiconductor laser diode and driving circuit)

The short circuit wiring between the semiconductor laser diode and the driving circuit, which is a feature of the invention, will be described in detail below

referring to the drawings. In the optical pickup device, the flexible substrate F is mounted on the optical pickup apparatus PU, and various kinds of electronic components are incorporated in the flexible substrate F and connected to each unit provided on the optical pickup unit PU. At this point, it is worthy of note that each unit in the optical pickup unit PU is not always connected to the electronic components on the flexible substrate F in the shortest distance because the flexible substrate F is mounted so as to be folded and wrapped depending on a shape of the optical pickup unit PU.

For example, as shown in FIGS. 2 and 3, the driving circuit 15 for the semiconductor laser diode mounted on the flexible substrate F is connected to the semiconductor laser diode 11 in the integrated optical unit 21 through a connector 13 and a wiring path A on the flexible substrate F. Accordingly, the long wiring path is formed and the attenuation of the driving signal and the generation of heat occur under the influence of the line inductance. This causes the degradation of the writing characteristics, in particular, in the case of the writing processing which requires the laser driving current of the about tenfold of energy compared with the reading.

A short-circuit wiring portion 14 according to the embodiment of the invention, provided as the extension

of the flexible substrate F, has the shape shown in
FIG. 1. When connectors 12 and 13 of the flexible
substrate F are connected to the integrated optical
unit 21 for DVD as shown in FIG. 3, the short-circuit
5 wiring portion 14 is integrally formed by routing the
wiring from the connector 13. As shown in FIG. 2, the
short-circuit wiring portion 14 is routed in proximity
to the integrated circuit having the driving circuit 15
of the flexible substrate F, and, as shown in FIG. 3,
10 an end portion of the short-circuit wiring portion 14
is folded and soldered to the flexible substrate F to
be connected to the integrated circuit with the
shortest distance. Thus, by the routing the short-
circuit wiring portion 14 so as to crawl through
15 clearance of the structure, mechanical stability can be
brought into the wiring.

For example, an anode and a cathode of the
semiconductor laser diode 11 are connected to the
driving circuit 15 with the short-circuit wiring
20 portion 14 through the connector 13.

Accordingly, driving current is supplied from the
driving circuit 15 to the semiconductor laser diode 11,
and thereby the optical disk is irradiated with the
laser beam emitted from the laser diode 11.

25 Furthermore, on the flexible substrate F, it is
possible that there is a wiring path between the
driving circuit 15 and the semiconductor laser diode 11

of the integrated optical unit 21 besides the pathway of the short-circuit wiring portion 14, mainly power of the semiconductor laser diode 11 is supplied from the driving circuit 15 to the semiconductor laser diode 11 through the connector 13.

FIG. 5 shows the wiring path A (ground line) in the case where the semiconductor laser diode is connected to the driving circuit by utilizing the wiring path formed on the flexible substrate F and a wiring path B (signal line) in the case of utilizing the short-circuit wiring portion 14 according to the embodiment of the invention. According to FIG. 5, the semiconductor laser diode can be connected to the driving circuit in the distance of about 10% of the wiring path A (ground line) on the flexible substrate F with the short-circuit wiring portion 14 according to the embodiment of the invention. This allows avoidance of the problem such as the unnecessary radiation, the unnecessary generation of heat, and unstable operation caused by disturbance, and the recording/reproducing processing to the optical disk with the stable laser emission.

On the other hand, in the same way as the case of DVD, a short-circuit wiring portion 16 is also provided between laser diode of the integrated optical unit 23 for CD and the driving circuit 15. By way of example, the anode and cathode of a semiconductor laser diode

11b are supplied from the driving circuit 15 to the short-circuit wiring portion 16 through a connector 25.

Further, on the flexible substrate F, there is a wiring path between the driving circuit 15 and the semiconductor laser diode 11b of the integrated optical unit 23 besides the pathway of the short-circuit wiring portion 16, mainly power of the semiconductor laser diode 11b is supplied from the driving circuit 15 to the semiconductor laser diode 11b through the connector 25.

FIG. 5 shows a wiring path C in the case where the semiconductor laser diode 11b of the integrated optical unit 23 is connected to the driving circuit 15 by utilizing the wiring path formed on the flexible substrate F and a wiring path D in the case of utilizing the short-circuit wiring portion 16 according to the embodiment of the invention. According to FIG. 5, the semiconductor laser diode 11b can be connected to the driving circuit 15 in the distance of about 80% of the wiring path A (ground line) on the flexible substrate F with the short-circuit wiring portion 16 according to the embodiment of the invention. Like the case of DVD, this allows avoidance of the problem such as the unnecessary radiation, the unnecessary generation of heat, and unstable operation caused by disturbance, and the recording/reproducing processing to the optical disk with the stable laser

emission.

Except that the short-circuit wiring portion according to the embodiment of the invention is provided as a part of the flexible substrate F, it is preferable to provide the short-circuit wiring portion as the wiring independent of the flexible substrate F or the wiring using a second flexible substrate. In this case, the same principle as the above-described effect and advantage also enables the recording/reproducing processing to the optical disk with the stable laser emission.

Though those skilled in the art can realize the invention by the various embodiments described above, it is easy for those skilled in the art to think of various kinds of modifications of the embodiments and to apply the invention to various modes without any inventive ability. Accordingly, the invention covers a wide range consistent to the disclosed principle and the novel feature and is not limited to the above-described embodiment.

As described in detail above, according to the invention, the optical pickup device and the optical disk device using the same, which allow the stable recording processing without unnecessary radiation and the generation of heat in a manner that provides the flexible substrate having the short-circuit wiring portion which directly connects the integrated optical

unit having the semiconductor laser diode to the driving circuit for the semiconductor laser diode, which is mounted on the flexible substrate.